to be the number of units of sun-heat incident perpendicularly on a unit-surface, in a unit of time, at the upper limit of the earth's atmosphere; or it is the number of degrees Centigrade a unit-mass of water would be raised in temperature by the sun-heat incident perpendicularly on a unit-surface, in a unit of time, at the upper limit of the atmosphere. The three units here indicated are, of course, arbitrary. But most physicists, following the example of Pouillet (*Comptes rendus*, vii. 24), take the gram, square centimetre, and minute, as respectively the units of mass, surface, and time. With regard to time, there is no diversity, the minute being universally used; but, for mass and surface, some employ the larger units of a kilogram and a square metre, and hence the apparent confusion. To obtain a general expression for the value of the 'solar constant,' let

Q = Quantity of sun-heat incident normally on a unit-surface in a unit of time = solar constant.
S = Area of surface receiving the heat.
T = Time of receiving the heat.
m = Unit mass of water.
n = Number of unit masses of water heated.
$t°$ = Rise in temperature of the mass of water.

Then we have

$$Q \times S \times T = n \times m \times t°.$$

Consequently, when S, T, and n are severally equal to unity, we have $Q = m \times t°$; and, when $m = 1$, $Q = t° =$ rise in temperature of a unit-mass of water = value of solar constant in units of heat.

Now, when the unit of time remains the same, but the units of mass and surface are changed, the value of $t°$ (which measures the solar constant) will be altered, unless both of these units are changed in the same ratio. For, from the equation $Q = m \times t°$, it follows that $t°$ varies as $\frac{Q}{m}$; but evidently Q is proportional to the magnitude of the unit of surface: hence $t°$ varies as $\frac{\text{unit of surface}}{\text{unit of mass of water}}$.

For example: using Pouillet's units, Langley's recent experiments make the solar constant = 2.84; that is, the sun-heat incident normally on one square centimetre, in one minute, at the upper limit of the atmosphere, would raise the temperature of one gram of water 2.84° C., or would heat 2.84 grams of water 1° C. Now, the unit remaining the same, if we assume the unit of mass to be one kilogram (1,000 grams), and the unit of surface to be one square metre (10,000 square centimetres), we should have the value of the constant $t'° = \frac{10{,}000}{1{,}000} \times 2.84 = 28.4$ kilogram-units of heat; that is, the sun-heat incident normally on one square metre, in one minute, at the upper limit of the atmosphere, would raise the temperature of one kilogram of water 28.4° C., or would heat 28.4 kilograms of water 1° C.

Moreover, as it requires a definite number of units of heat to liquefy a unit-mass of ice, or to evaporate a unit-mass of water, or to produce a unit of mechanical energy, it follows that this constant may be measured by either of these units.

The exact determination of the value of this constant is a most refined and difficult experimental problem; for it involves the precise estimation of the amount of solar heat absorbed in traversing the earth's atmosphere, or the law of extinction of sun-heat in passing through it: hence it is, that, although several excellent physical experimenters have attacked the problem, their results are not so accordant as would be desirable. The following are some of the results:—

EXPERIMENTER.	DATE.	SOLAR CONSTANT.	
		Gram-units of heat per square centimetre per minute.	Kilogram-units of heat per square metre per minute.
Pouillet . .	1838	1.7633	17.633
Forbes . .	1842	2.847	28.47
Crova . . .	1876	2.323	23.23
Violle . . .	1876	2.540	25.40
Langley . .	1882	2.840	28.40

JOHN LECONTE.

Berkeley, Cal., June 25, 1883.

WARD'S DYNAMIC SOCIOLOGY.

Dynamic sociology, or applied social science, as based upon statical sociology and the less complex sciences. By LESTER F. WARD, A.M. 2 vols. New York, *Appleton*, 1883. 20+706; 7+690 p. 8°.

I.

THIS work of Mr. Ward is composed of two distinct parts. The first gives the outlines of his philosophy, as a basis for his reasoning in the one that follows. The second is a discussion of the causes and consequences of progress, or evolution, in human society. For some purposes it would have been wise to give each part a distinct title, reserving for the last part the one used; but the philosophic system propounded in the first part has evidently been prepared as a basis for the second, and in itself would not be considered by the author as a complete exhibit of his philosophy.

Vol. i. contains: first, an outline of the work, in which the author's purposes are clearly set forth; second, an historical review, chiefly devoted to a discussion of the philosophies of August Comte and Herbert Spencer; third, the cosmic principles underlying social phenomena, in which the outlines of the new system are set forth. Under the general title of 'primary aggregation,' he discusses the constitution of celestial bodies and chemical relations. Under that of 'secondary aggregation,' he discusses biology, psychology, and the genesis of man. Under that of 'tertiary aggregation,' he discusses the genesis of society and the characteristics of social organization. The purpose of this preliminary volume on general philosophy, and of the introduction to the second volume, is tersely given by Mr Ward himself, as follows:—

"The purpose of the present chapter [chap. viii.], as already announced, has been to accomplish the complete orientation of

the reader for the voyage before him. Without this, much that is to come might appear meaningless, or at least lose its point.

"Men think in systems. Most systematic treatises are unintelligible unless followed from the beginning and grasped in their entirety. A fundamental tone runs through them which prescribes the special sense of every line, and which is wholly unheard in isolated passages. The careful reader of such works, without necessarily acquiescing in the author's views, is able at least to comprehend them and to do justice to them." . . .

"In the following argument, now to be briefly stated, and subsequently to be fully elaborated, the statements made in this chapter, as well as those contained in the preceding volume, are to be taken as the basis, or premises, and must be granted 'for the sake of the argument' at least, however unsound they may be deemed in themselves."

Elsewhere the theory is more fully elaborated, that the more complex sciences can be grasped only as the more simple sciences upon which they are based are properly understood, and that anthropologic sciences in general must rest firmly upon physics and biology. Though the reader may differ from Mr. Ward in relation to his classification and conclusions, he will still be interested in the symmetry of his system and the perspicuity of his presentation.

The essential principle running through the treatise is, that progress in society is based upon the struggle for happiness in the same manner as biologic progress is based upon the struggle for existence. It is therefore a new system, in radical contrast with that taught in our schools and enunciated by the majority of publicists of the present day, of whom Herbert Spencer is the chief. For this struggle for happiness the term 'conation' (*conari*, to endeavor) is used, taken from Sir William Hamilton; and he says, "The term 'conation' will be employed in this work to represent the efforts which organisms put forth in seeking the satisfaction of their desires, and the ends thus sought will be designated as the 'ends of conation.'"

Again, the author classifies phenomena as *genetic* and *teleologic*. Genetic phenomena are such as appear in series, with natural antecedents and consequents, unaffected by design or purpose. Teleologic phenomena do not appear in natural series, the antecedents being physical phenomena controlled by design existing in mind, and the consequents being the purposes for which the will is exercised. Throughout the work these two classes of phenomena are clearly distinguished; but it is impossible, in a brief review, to set forth fully the importance of the distinction, as the author himself has done. In general terms, it may be stated that biologic progress is due to the struggle for existence, and involves genetic phenomena; while sociologic progress is due to the struggle for happiness (conation), and involves teleologic phenomena.

"All progress is brought about by *adaptation*. Whatever view we may take of the cause of progress, it must be the result of a correspondence between the organism and the changed environment. This, in its widest sense, is adaptation. But adaptation is of two kinds. One form of adaptation is *passive* or *consensual*, the other form is *active* or *previsional*. The former represents *natural* progress, the latter *artificial* progress. The former results in a *growth*, the latter in a *manufacture*. The one is the *genetic* process, the other the *teleological* process. In passive adaptation the means and the end are in immediate proximity, the variation takes place by infinitesimal differences; it is a process of *differentiation*. In active adaptation, on the contrary, the end is remote from the means; the latter are adjusted to secure the former by the exercise of *foresight;* it is a process of *calculation*."

By the term 'dynamic sociology,' as used by the author, is to be understood a systematic treatise on the forces which impel mankind into social relations, to develop social organization, and to provide and modify the institutions of society. The subject-matter of dynamic sociology, appearing in the second volume, is arranged in the following order, as set forth by the author: —

"The remainder of this work will chiefly consist in the discussion of six terms; and therefore, before entering upon such discussion, it is a primary necessity to furnish rigid definitions of each of these terms.

"For a purpose which will presently appear, we will assign to each of these terms a letter, which will fix their order in a series not admitting of any alteration.

"The first of these terms, which we will designate by the letter A, is *happiness;* the second, which we will designate by B, is *progress;* the third, which we will designate by C, is *dynamic action;* the fourth, which we will designate by D, is *dynamic opinion;* the fifth, which we will designate by E, is *knowledge;* and the sixth, which we will designate by F, is *education*.

"The definitions of these six terms are as follows:

"A. Happiness. — Excess of pleasure, or enjoyment, over pain, or discomfort.

"B. Progress. — Success in harmonizing natural phenomena with human advantage.

"C. Dynamic action. — Employment of the intellectual, inventive, or indirect method of conation.

"D. Dynamic opinion. — Correct views of the relations of man to the universe.

"E. Knowledge. — Acquaintance with the environment.

"F. Education. — Universal distribution of extant knowledge.

"Corresponding to these six terms thus defined, there are six theorems of dynamic sociology, which require to be elaborated and established, and to each of which a separate chapter will be devoted.

"Continuing the literal designations, these theorems are the following: —

"A. Happiness is the ultimate end of conation.

"B. Progress is the direct means to happiness; it is, therefore, the first proximate end of conation, or primary means to the ultimate end.

"C. Dynamic action is the direct means to progress; it is, therefore, the second proximate end of conation, or secondary means to the ultimate end.

"D. Dynamic opinion is the direct means to dynamic action; it is, therefore, the third proximate end of conation, or tertiary means to the ultimate end.

"E. Knowledge is the direct means to dynamic opinion; it is, therefore, the fourth proximate end of conation, or fourth means to the ultimate end.

"F. Education is the direct means to knowledge; it is, therefore, the fifth proximate end of conation, and is the fifth and initial means to the ultimate end."

The remaining six chapters of the work, namely, chapters ix., x., xi., xii., xiii., xiv., treat of these six subjects *seriatim*.

In chapter ix., then, the doctrine is set forth that happiness is the ultimate end of conation, or human endeavor. Here Mr. Ward discusses the nature and genesis of feeling, as the proper basis of a philosophic system involving the interests of man; and he subsequently endeavors to show, that, what function is to biology, feeling is to sociology. And after a discussion of the intellectual method as compared with the physical method of conation, and several collateral subjects, he sets forth the doctrine that degree of feeling is concomitant with degree of organization, and that the pursuit of happiness by man leads to higher physical, mental, and social organization; that, in turn, such higher organization increases feeling, and thus increases pleasure, and thus increases happiness.

Chapter x. is devoted to the consideration of progress as the primary means to happiness, and includes: a discussion of the difference between dynamic sociology and moral science; then a discussion of the growth of the means for communicating ideas, — language in all its forms; then of the arts and industries which are developed in the pursuit of subsistence; then the origin of government and the institutions of government; and, finally, the origin and institutions of religion.

Chapter xi. is entitled 'Action,' — a term chosen in preference to the more common expression, *conduct*. The chapter is chiefly devoted to the discussion of a systematic classification of actions, first, as involuntary and voluntary; and voluntary actions are again divided into impulsive or sensori-motor, and deliberative or ideo-motor. Each of the latter classes consists of two groups; namely, actions possessing moral quality, and actions devoid of moral quality.

It is no part of the author's purpose to treat of action possessing moral quality; although, in order to make clear the irrelevancy of such actions to his discussion, he occupies some space in going over the ground usually covered by writers on ethics. Actions devoid of moral quality are those upon which progress essentially depends, and chiefly that branch which falls under the more general head of deliberative or ideo-motor actions. They are further subdivided into static and dynamic, the former group embracing the great bulk of human activities in the performance of the ordinary duties of life. Static actions of this class do not result in progress, but tend simply to preserve the existing social status. Dynamic actions constitute the really progressive class of actions.

The chief fact which distinguishes dynamic actions from all others is, that they are performed by the indirect or inventive method. All the progress that has taken place in society has been due to such action. However spontaneous such progress may appear, it has, nevertheless, been the result of teleologic methods in adjusting natural phenomena in such a manner that they will accomplish desired ends, — remote in themselves, but foreseen by the intelligence of the developing intellect. The results are the essential elements of human

art; and consequently civilization is fundamentally and wholly artificial. Here Mr. Ward introduces a series of illustrations of typical dynamic actions performed in the course of social progress, for the purpose of elucidating the central idea which he desires to embody in the term 'dynamic action.'

Chapter xii. is a discussion of opinion as the direct means to progressive action. As dynamic actions are ideo-motor, such actions must result from the possession by the agent of certain underlying and directing ideas. The truism that 'ideas rule the world' simply means, that opinions determine actions. But in order to produce dynamic actions, — that is, actions which will, in fact, result in progress, — it is essential that the opinions which underlie them be in rigid harmony with objective reality. Dynamic action can only flow from correct opinion.

Opinions must not only be correct, they must be important. Unless important, no appreciable dynamic result will flow therefrom. The most important opinions, or ideas, are arranged under four general heads: first, cosmologic ideas; second, biologic ideas; third, anthropologic ideas; fourth, sociologic ideas. Correct ideas belonging to these four great classes constitute the primary motive power to all human progress.

Chapter xiii. is upon knowledge, — the immediate data of ideas. Opinions cannot be directly reached. They are not subject to the will, either of the party holding them or of any other: they are simply consequents. Obviously, the antecedents of ideas consist in the data possessed by the mind relative to the materials and phenomena of nature. Such data are grouped by the author under the general term 'knowledge.' Knowledge, therefore, must first exist; and, if it exist, no effort need be expended in determining opinion. In this chapter the author shows that the chasm which in fact separates the intelligence of the lowest and the highest classes of mankind is chiefly due to inequality in the possession of the data for thought. He shows that the capacity of the mind is, in any particular class of society, practically equal; that, even in what are known as semi-civilized or barbaric races, the capacity exists for a far greater amount of knowledge than is ever obtained.

Chapter xiv. is on education as the direct means to knowledge. The possession of knowledge, therefore, if it could be secured, would constitute the true means to the proximate end, and thus secure the ultimate purpose. But the human mind is so constituted that it cannot be safely intrusted to secure this end for itself; for the individual cannot understand the necessity for this knowledge, or guide himself wisely in its attainment, prior to its acquisition: that is, the period of acquisition is in the earlier years of the life of the individual, when he must be guided by others. The initial means in the entire series is therefore education, actively considered as a function of society.

The work closes with a condensed but fundamental treatment of the general subject of popular education, in which appears a review of the various theories that have been held, and that still control human action on this subject. He divides the general body of public opinion into five parts, which he denominates 'the five kinds of education.' These are: first, education of experience; second, of discipline; third, of culture; fourth, of research; fifth, of information. The first four of these kinds of education are considered for the purpose of showing, that, however important in themselves, they are insufficient to accomplish the great end of securing an artificial civilization as the product of direct social action. The last of these forms of education, therefore, is the only one which embodies such promise.

The author sees little hope in the imperfect and desultory attempts of individuals to secure this great need in society. To render it of any value, he claims that education must be the systematic work of society in its organized capacity. Ceasing to exert itself longer in vain attempts to secure directly the various proximate ends, society should vigorously adopt this inital means, and concentrate its energies on the work which is clearly practicable, — that of furnishing to all its members the data actually in its possession.

Under the heading 'Matter of education' the author briefly, but without dogmatism, discusses the general theorem that the subject-matter should be a knowledge of nature, — a knowledge of the environment of the individual and of mankind. His treatment of the methods of popular instruction is brief, maintaining that this is merely a matter of supply in the politico-economic sense, which will certainly come as soon as there shall be an adequate demand. He says, "The methods and the teachers have always been as good as the popular notions of education, and they will doubtless continue to be so." The only criterion which he does lay down with regard to method is that it be teleologic. He insists that education, like every other department of civilization, must be an artificial product; that it

must be undertaken deliberately, planned by human intelligence, and achieved through human effort.

The author discusses, in a broad and philosophic manner, a great body of questions in which civilized man is deeply interested. He has therefore written for a wide reading; and happily his style, in its essential characteristics, will not repel those to whom it is presented.

GEOLOGY OF SOUTHERN PENNSYLVANIA.

Second geological survey of Pennsylvania. — Report of progress T². — The geology of Bedford and Fulton counties. By J. J. STEVENSON. Harrisburg, *Survey*, 1882. 15+382 p., 2 maps. 8°.

PROFESSOR STEVENSON has made a detailed survey of the district, which has led to but few material changes in the map of the first survey. The descriptions of the structural geology are careful, plain, and easily understood; and the second part of the report, consisting of a day-book of observations along the roads, with reference to outcrops, mines, and quarries, will doubtless prove very useful.

It is well that Professor Stevenson has not completely neglected paleontology in his descriptions of the various formations; but this feature of his report is capable of much improvement, only about sixty species being cited as occurring in a section that extends from the upper coal-measures to the calciferous. The value of his determinations, and the scientific interest of his work, would have been much increased, if care had been taken to collect and determine the fossils found in each group, and lists of them published, together with the localities in which they occurred. It is not meant to infer that Professor Stevenson's determinations are incorrect, but simply that he gives no evidence in support of them. For instance: he says, "Some of these layers contain fossils which are *distinctly Chemung*, none whatever of Portage type being present; but, owing to the weathering, the forms can be identified only generically." The writer does not think he is alone in doubting whether there are any fossils which are distinctively Chemung. At any rate, it would be interesting to know what these genera are. He mentions no fossils in his Hudson River group, and in the Trenton mentions only three forms, which are also very common at the top of the lower Silurian. The director of the survey, in his letter of transmittal, makes the following curious remark, which seems to indicate a peculiar conception of the objects of paleontology. He says, "Paleontologists will find it an easy task to copy out from the index, separately, the whole list of fossil names, and arrange them afterwards to suit their own purposes." Certainly, paleontologists do not want to arrange fossils to suit themselves, but to find out how nature has arranged them. The two maps accompanying the report are of very indifferent quality, as it is difficult, especially over the Broad Top area, to follow on the maps the descriptions in the text. Mr. Stevenson disclaims responsibility for several things in them, which may account for the discrepancies between the text and the maps. Professor Lesley seems to think that the maps may be easily followed by a person familiar with the country; but the maps should have been constructed so that others, also, may be able to understand them. He seems to apply preconceived notions of orography, whether it agrees with the geology as studied in the field or not; and, if the responsibility of preparing the maps rested with the same person who has done the field-work and prepared the text, the result would probably be more intelligible. Mr. Stevenson mentions a bed 195 feet above the Pittsburg coal. This would apparently belong to the upper series, considered Permian in other reports of the survey; but this does not appear to be represented anywhere on the map.

WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

ASTRONOMY.

Eclipses of Jupiter's satellites. — Cornu proposes to observe these eclipses photometrically, comparing the light of the satellite during the time while it is entering or emerging from the shadow with that of an artificial satellite visible in the same field, and made to vary in brightness at pleasure by an adjustable 'cat's eye,' so called. He shows that the moment when the light of the satellite is *half* that of its unobscured condition is the one which can be most accurately determined, and urges that the photometric observations should be so arranged as to give an automatic record. Admiral Mouchez has authorized the application of the necessary apparatus to one of the large equatorials of the Paris observatory.

M. Cornu does not seem to be aware that a very similar, but really more precise, method of observa-